REMARKS

Claim 1 has been amended in response to the rejections herein under 35 U.S.C. §§102 and 103. Reconsideration of this application in view of this amendment and the following remarks is respectfully requested.

The Examiner objects to the drawings under 37 §CFR 1.83(a) for failure to disclose laterally offset catalyst sections as specified in the claims. Reconsideration and withdrawal of that objection are respectfully requested in view of Fig. 8 of the drawings and the disclosure at beginning at page 14, line 28 and continuing over to page 15, line 2 of the specification. As explained in the cited portion of the specification, the cell walls of the lower catalyst section in Fig. 8, clearly shown in phantom, are laterally offset from the cell walls of the upper catalyst section. Therefore the laterally offset feature of the claims is clearly shown in Fig. 8, and correction of the drawing should not be required.

The Examiner has next rejected claims 5 and 9 of the application as indefinite under 35 U.S.C. §112, second paragraph. With respect to claim 5, the Examiner cited the term "laterally offset" as unclear, concluding that the drawings were insufficient to clarify the difference between "laterally offset" and "rotationally offset" catalyst sections.

This rejection is respectfully traversed in view of Figs. 4 and 8 of the drawings, and the description of those drawings at pages 11, lines 7-24 and page 14, line 28 to page 15, line 2 of the specification. As described at page 11, Fig. 4 illustrates the nature of the channel and feed stream divisions resulting from a 45° rotational offset of catalyst sections in accordance with Fig. 3. That offset causes the cell walls of the lower catalyst section to diagonally traverse the channel openings of the upper catalyst section. In contrast to Fig. 4, Fig. 8 illustrates the channel walls of the lower catalyst section (shown in phantom) traversing the channels of the upper catalyst section in a direction parallel to the sidewalls of the upper section channels. Thus the difference in flow division geometry between rotational and lateral catalyst section offsets can be fully understood from the illustrations of Figs. 4 and 8.

The rejection of claim 9 for indefiniteness is respectfully traversed in view of the disclosure at page 1, lines 14-22 and page 8, lines 9-17 of the specification. As those descriptions clearly show, the term co-current simply refers to flow condition under which the gas and liquid feed stream components flow in the same direction

through a monolithic catalyst. Thus the gas flows co-currently with the liquid. This terminology is well understood in the art, as shown by the monograph "Structured Catalysts and Reactors", A. Cybulski and J. Moulijn, Editors, Marcel Dekker, New York (1998), pages 240-244 (hereinafter Cybulski), a copy of which is submitted herewith.

For the above reasons, reconsideration and withdrawal of the rejection of claims 5 and 9 under 35 U.S.C. §112 are respectfully requested.

The Examiner has next rejected claims 1, 2 and 4-9 of the application as being anticipated by Ruff et al. (Ruff, U.S. Patent No. 3,208,131). Ruff was cited to show structured catalyst sections within a reactor vessel with channels offset between the sections, the channels being of substantially the same size, both rotationally and laterally offset, and with a separator between sections. The reference was further relied on to show co-current fluid flow through the sections.

This rejection is respectfully traversed for the reason that Ruff fails to teach or suggest a gas-liquid reactor or a method for processing a gas-liquid feed stream. The reactor of Ruff is designed for the treatment of a combustible exhaust stream (column 1, line 30 of the patent), such as a particle laden gas stream (column 3, line 12 of the patent). The catalyst is designed to effect the oxidation or incineration of combustibles present in such exhaust streams (column 5, line 31 of the patent).

For this application, the plurality of elements in the Ruff reactor are provided mainly to accommodate thermal expansion variations in the catalyst caused by temperature variations through the reactor (column 1, line 41 of the patent). The only other mentioned advantage of this design is the possibility that gas turbulence might dislodge particles adhering to the catalyst in use (column 3, line 14 of the patent)

It is evident from a reading of the Ruff disclosure that the processing of a gas-liquid feed stream as required by claims 1-9 of the application is neither taught nor suggested. Thus Ruff not only fails to anticipate a fundamental limitation of the Applicants' claims, but also fails to suggest the unexpected advantages of the process of the invention for the treatment of gas-liquid feed streams.

The advantages of channel offsets for gas-liquid processing reside in the improved conversion efficiencies secured thereby (Figs. 6 and 7 of the drawings). These improvements are achieved without the use of separate flow distributors or

mixers to increase interaction with the catalyst (page 9, lines 9-19 of the specification).

More importantly, these efficiency improvements are contrary to the expectations of those of ordinary skill in the art. The conventional understanding in this field is that stable flow patterns, rather than disrupted patterns, are required in gas-liquid reactors to optimize monolith reactor efficiency.

The above-cited Cybulski monograph describes the various types of gas-liquid flow that have been observed in monolith reactors. As reported beginning at page 244 of this publication, the performance of monolithic reactors has been viewed as highly dependent on the prevailing gas-liquid flow pattern. The desired flow pattern through the monolith is segmented flow, with optimum reactor performance being achieved with uniform and stable distribution of gas and liquid across the reactor.

The above teachings suggest that flow disruptions would be detrimental to reactor efficiency. Yet the Applicants have shown the reverse to be the case. Higher gas-liquid conversion efficiencies are achieved in the Applicants' gas-liquid reactors as the number of offset catalyst sections, and thus the number of feed stream divisions, is increased. The amendment to claim 1 of the application is intended to more clearly point out that claims 1-6 of the application pertain only to the specific field of gas-liquid reactor design.

For the above reasons the Applicants respectfully submit that Ruff neither teaches nor suggests the subject matter of rejected claims 1,2 and 4-9 of the application. Accordingly, reconsideration and withdrawal of the rejection of those claims under 35 U.S.C. §102 are respectfully requested.

The Examiner has next rejected claims 1, 3-5 and 7-9 of the application under 35 U.S.C. §102 as fully anticipated by Hervert et al. (Hervert, U.S. Patent No. 3,785,781). Hervert was cited to show essentially the same prior art features as those taught by Ruff, i.e., a reactor with multiple catalyst sections wherein the channels in the sections are offset. This rejection is respectfully traversed for the following reasons.

The Hervert reactor is a reactor for the catalytic treatment of exhaust gases from e.g., motor vehicle engines. Thus the feed stream being treated is a hot, pollutant-containing gas stream (column 1, lines 49-60 of the patent). The objective of the reactor design is to disrupt a stagnant boundary layer of exhaust gas formed in

downstream sections of the catalyst when processing such a stream (column 5, lines 9-21 and column 6, lines 29-35 of the patent).

As is Ruff, Hervert is silent as to reactor designs and processes for the treatment of two-phase (gas-liquid) feed streams. Thus the Hervert invention involves only the processing of single-phase, generally gas-phase, reactants. Absent any express or inherent disclosure of a gas-liquid treatment process by Hervert, it is therefore evident that the Hervert disclosure cannot anticipate the subject matter of the rejected claims. Accordingly, reconsideration and withdrawal of the rejection of claims 1, 3-5 and 7-9 of the application under 35 U.S.C. §102 as fully anticipated by Hervert are respectfully requested.

Finally, the Examiner has rejected claims 2, 3 and 6 of the application 35 U.S.C. §103 on reference to Hervert alone or the combination of Hervert and Ruff. Reconsideration and withdrawal of these rejections are respectfully requested in view of the following remarks.

The Examiner concludes that varying the shapes and sizes of the channels in Ruff would have been obvious in light of Hervert, that providing adjacent catalyst sections of differing channel size and shape was contemplated by Hervert, and that Ruff obviates the use of spacers in the reactors of Hervert. From a technical standpoint, however, those conclusions have no obvious applicability to processes for the treatment of two-phase gas-liquid feed streams, or reactor designs appropriate for such processes. The Cybulski monograph, supra, demonstrates that the fluid flow considerations applicable to gas-liquid processing are quite distinct from the gas-phase phenomena described by either of Ruff or Hervert. Thus the art does not presently support the prediction of gas-liquid processing results based on gas phase processing results or analysis.

Further, the rejection of claims 2, 3 and 6 under 35 U.S.C. §103 overlooks the unexpected enhancements in gas-liquid reactor efficiency resulting from the processes and reactor designs defined by the rejected claims. The level of technical understanding in the art of gas-liquid reactors is believed fairly reflected in the Cybulski and Mouljin monograph, and that understanding is essentially that reactor efficiencies are favored by stable Taylor flow or segmented flow feed stream profiles in monolithic catalyst channels.

Given this state of the art the Applicants respectfully contend that neither Hervert nor the combination of Hervert and Ruff would establish any reasonable

expectation in the mind of experts in this field that the Applicants' reactor designs and processes would produce increases rather than decreases in gas-liquid reactor efficiency. Accordingly it is respectfully submitted that the subject matter of rejected claims 2, 3 and 6 is in fact unobvious from and patentable over Hervert, Ruff, or any combination thereof.

For all of the above reasons, the Applicants respectfully submit that claims 1-9 of this application as amended are patentable over the art of record in this case, and should be allowed. Accordingly, reconsideration of this application and allowance of all remaining claims are courteously solicited.

Respectfully submitted,

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

--1.(amended) A catalytic reactor for treating a gas-liquid feed stream with structured monolithic catalysts of honeycomb configuration comprising:

a reactor vessel for the containment of a catalyst bed for processing a ~~chemical~~ gas-liquid feed stream;

a catalyst bed comprising two or more sections of structured honeycomb catalyst disposed within the reactor vessel, the catalyst bed including at least a first catalyst section and a second catalyst section disposed in flow-connected end-to-end relationship with the first catalyst section;

each of the first and second catalyst sections having an inlet end, an outlet end, and a plurality of parallel open-ended honeycomb channels bounded by channel walls with catalytically active wall surfaces extending between the inlet and outlet ends, the channels of both sections being oriented along a common flow axis of feed stream flow through the catalyst bed;

the channels in the second catalyst section being offset from the channels in the first catalyst section such that at least a majority of the channels in the first catalyst section have outlet ends opening onto at least one channel wall segment and at least two adjoining channel openings at the inlet end of the second catalyst section. --